Argonne NATIONAL LABORATORY

Argonne Leadership Computing Facility

ALCF: Leadership-Class Computing for Breakthrough Science and Engineering

Enabling Scientific Discovery for Today and Tomorrow

The Argonne Leadership Computing Facility (ALCF) enables breakthrough science—science that will change our world through major advances in biology, chemistry, energy, engineering, climate studies, astrophysics and more.

Operated for the U.S. Department of Energy's Office of Science, the ALCF gives leading scientists access to world-class computation resources and a dedicated team of computational scientists and engineers to support their research efforts.

Work under way at the ALCF spans a spectrum of scientific disciplines. For example, current projects will allow researchers to:

- Understand the molecular basis of Parkinson's disease
- Assess the impacts of climate change
- Explore Type Ia supernovae
- Design technologies to reduce aerodynamic noise
- Gain insight into dangerous heart rhythm disorders
- Understand the basic building blocks of nature
- Make safe, clean nuclear energy available globally

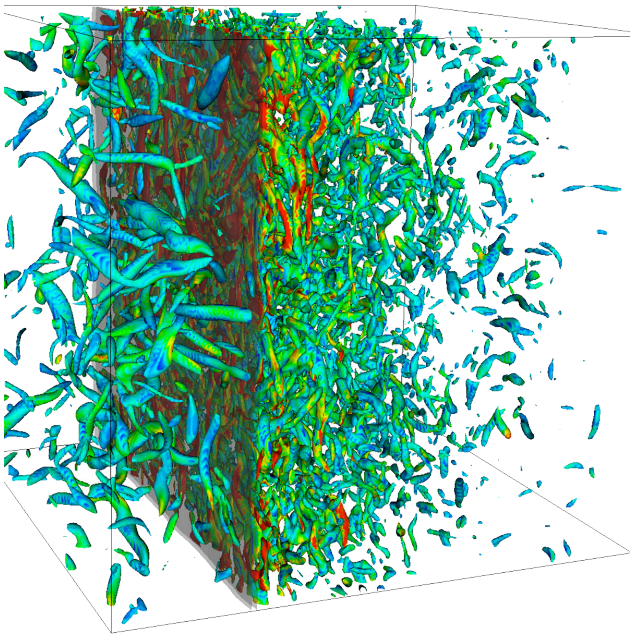
Advancing Science with Powerful Resources

The ALCF is home to the IBM Blue Gene/P Intrepid, one of the fastest supercomputers in the world for open science. Intrepid features 40,960 quad-core compute nodes (163,840 processors) and 80 terabytes of memory. Intrepid boasts a peak performance of 557 teraflops, solidifying the ALCF's position as a leadership-class center for computation-driven scientific discovery. Despite its power, the energy-efficient system uses about one-third as much electricity as a machine of comparable size built with more conventional parts. In recognition of its significant energy savings, Argonne was awarded the HPCwire's Readers' Choice Award for Best Application of Green Computing at the annual Supercomputing Conference (SC09), held November 14-20, 2009 in Portland, OR.

HPCwire Readers' Choice Awards 2009

The ALCF also operates Surveyor, a Blue Gene/P system with 1,024 quad-core nodes (4,096 processors) and 2 terabytes of memory. Surveyor is used for tool application porting, software testing and optimization, and systems software development. IBM received the 2008 National Medal of Technology and Innovation for its Blue Gene supercomputers.

IBM Blue Gene Supercomputer recipient of the 2008 National Medal of Technology and Innovation

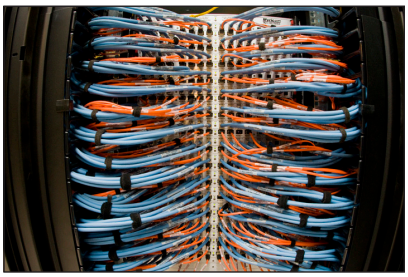


In a fundamental study of shock/turbulence interaction, turbulent eddies are amplified upon passing through a shock wave. This research used resources of the Argonne Leadership Computing Facility at Argonne National Laboratory, which is supported by the Office of Science of the U.S. Department of Energy under contract DE-AC02-06CH11357.

Breakthrough research under way at the Argonne Leadership Computing Facility delves into applied mathematics, climate research, combustion, nuclear physics, computer science and other scientific disciplines.

Other ALCF resources for networking, visualization, data analytics, and data storage include:

Networking



The Blue Gene/P uses five different networks for different communication operations. The 3D torus network is used for general-purpose, point-to-point message passing as well as for collective operations using irregular communication or large message sizes. Each node has six nearest neighbors. Each link provides a bandwidth of 425 MB/s per direction, for a total bidirectional bandwidth of 5.1 GB/s. Though each node has six bidirectional links on each node, there is only one shared DMA engine. The 3D torus network is also usable as a 3D mesh.

The supercomputer connects to other research institutions using a total of 30 Gb/s of public network connectivity. This allows scientists to transfer datasets to and from other institutions over fast research networks such as the Energy Science Network (ESNet) and the Metropolitan Research and Education Network (MREN).

Eureka

- Visualization and data analytics to transform data into useful knowledge
- 100 compute nodes: Each with (2) 2.0 GHz quad-core Xeon servers with 32 GB RAM
- 200 NVIDIA Quadro FX5600 GPUs in 50 S4s
- Memory: More than 3.2 terabytes of RAM
- Peak Performance: More than 111 mostly single precision teraflops of computation use a fraction of electricity compared to alternative architectures.

Gadzooks

- Test and development for visualization
- 4 compute nodes: Each with (2) 2.0 GHz quad-core Xeon servers with 32 GB RAM
- 8 NVIDIA Quadro FX5600 GPUs in 2 S4s

Data Storage

The supercomputer's data systems consist of 640 I/O nodes that connect to 16 storage area networks (SANs) that control 7,680 disk drives with a total capacity of 7.6 petabytes of raw storage and a maximum aggregate transfer speed of 88 gigabytes per second. The ALCF uses two parallel file systems—PVFS and GPFS—to manage the storage. An HPSS automated tape storage system provides archival storage.

Current tape capacity installed and available is 6,500 tapes at 800 GB raw, in a 10,000-slot library. A second 10,000-slot library and 9,500 tapes are expected to enter production in early 2010.

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